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## REPORT DOCUMENTATION PAGE

<b>AD-A198 519</b>		1b. RESTRICTIVE MARKINGS	
		3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.	
		4. PERFORMING ORGANIZATION REPORT NUMBER(S)	
5. MONITORING ORGANIZATION REPORT NUMBER(S) <i>ARO 22614.13-CH</i>		7a. NAME OF MONITORING ORGANIZATION U. S. Army Research Office	
6a. NAME OF PERFORMING ORGANIZATION The Pennsylvania State University		6b. OFFICE SYMBOL (If applicable)	
6c. ADDRESS (City, State, and ZIP Code) Department of Chemistry, 152 Davey Lab. University Park, Pa. 16802		7b. ADDRESS (City, State, and ZIP Code) P. O. Box 12211 Research Triangle Park, NC 27709-2211	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U. S. Army Research Office		8b. OFFICE SYMBOL (If applicable)	
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		10. SOURCE OF FUNDING NUMBERS	
8c. ADDRESS (City, State, and ZIP Code) P. O. Box 12211 Research Triangle Park, NC 27709-2211		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) The Synthesis and Structure of Polyphosphazenes			
12. PERSONAL AUTHOR(S) Harry R. Allcock			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM 4/15/85 TO 4/14/88	14. DATE OF REPORT (Year, Month, Day) 1988, June 13	15. PAGE COUNT 5
16. SUPPLEMENTARY NOTATION The view, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
		Polymers, inorganic, phosphazenes	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)  New methods have been developed for the synthesis of polyphosphazenes, including those with transition metals and pseudo-halogen units in the side chains. Studies have been carried out to generate structure-property correlations in phosphazene high polymers.			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL		22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL

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THE SYNTHESIS AND STRUCTURE OF POLYPHOSPHAZENES

Final Report

Harry R. Allcock

June 13, 1988

U. S. ARMY RESEARCH OFFICE

DAAG29-85-K-0111  
22614-CH

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The objective of this work was the synthesis and evaluation of new polymers derived from the inorganic elements. Specifically, the goal was to develop new methods of synthesis for polyphosphazenes and to develop an understanding of the ways in which changes in molecular structure alter the properties of the polymers and allow improved polymers to be designed.

First, a method has been developed for the synthesis of new polyphosphazenes with cyano side groups, and these have been used as precursors for the construction of organic side groups derived from the phosphazene-nitrile structure. The new polymers are expected to be useful as new films and elastomers.

Second, a number of new classes of cyclo- and polyphosphazenes have been prepared that incorporate transition metals, such as iron, ruthenium, chromium, or cobalt into the organometallic side group structure. These macromolecules are hybrid polymer-metal materials, some of which combine the properties of organic polymers with those of metals. Typical of these materials are polyphosphazenes with ferrocene units as side groups. These show semiconductor properties and unusual oxidation-reduction behavior.

Third, a series of small molecule linear phosphazenes have been prepared that serve as synthetic and structural models for the high polymers. X-Ray diffraction structure studies and theoretical analysis of the results have helped to predict ways in which the properties of the analogous polymers can be changed in order to optimize properties that are needed for advanced engineering uses.

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## TECHNICAL REPORTS

### Period covered:

April 15 1985 - December 31, 1985

January 1, 1986 - June 30, 1986

July 1, 1986 - December 31, 1986

January 1, 1987 - June 30, 1987

July 1, 1987 - December 31, 1987

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